THURSDAY, SEPTEMBER 23, 1909.

PHILOSOPHY AND HISTORY OF SCIENCE.

(1) *Das Prinzip der Erhaltung der Energie.* By Dr. Max Planck. Zweite Auflage. Pp. xvi+278. (Leipzig: B. G. Teubner, 1908.) Price 6 marks.

(2) *Vererbung, Gedächtnis und Transzendentale Erinnerungen vom Standpunkte des Physikers.* By Dr. Gustav Eichhorn. Pp. x+116. (Stuttgart: Julius Hoffmann, 1909.) Price 2.50 marks.

(3) *De la Méthode dans les Sciences.* By Profs. H. Bouasse, &c. Pp. 412. (Paris: Félix Alcan, 1909.)

(4) *Materialistische Epoche und monistische Bewegung.* By Paul Volkmann. Pp. 30. (Leipzig: B. G. Teubner, 1909.) Price 1 mark.

(5) *Das Theorem des Pythagoras.* By Dr. H. A. Naber. Pp. xii+240. (Haarlem: P. Visser, 1908.) Price 7s.

(6) *Essai sur la notion de Théorie physique de Platon à Galilée.* By Pierre Duhem. Pp. 144. (Paris: A. Hermann and Son, 1908.) Price 5 francs.

(7) *Il passato ed il presente delle principali Teorie geometriche.* Terza editione. By Prof. Gino Loria. Pp. xxiv+476. (Torino: Carlo Clausen, Hans Rinck Succ, 1907.)

(1) IN 1887 the Göttingen Faculty of Philosophy offered a prize for the best essay, historical and critical, on the physical concept of energy, and the principle of conservation of energy. The prize was awarded to Dr. Max Planck, and his essay now, in its second edition, finds a fitting place in the series which the Teubner Press are issuing bearing the title of the first volume by Poincaré, "Science and Hypothesis."

The volume is divided into three sections. The first is historical; the second deals with statements and proofs of the principle; while the third discusses the various forms of energy and their symbolic representations.

"The Principle of Conservation of Energy" is a somewhat elastic title for a thesis. Had Prof. Planck included every application of the principle or every investigation in which the principle plays an important part, his work would have swelled out into a treatise containing pretty well the whole of physics and a large part of chemistry. The author has been wise in restricting his inquiries to a narrow field. He excludes all reference to the less easily understood second law or principle of degradation of energy. That principle is far more difficult to understand than the first law, and it is doubtful whether at the time of writing the essay Prof. Planck could have been in a position to give a satisfying account of it. It teaches us that a community of molecules tends towards a state of socialism in which wealth in the form of energy is evenly distributed among the molecules, but that as the change takes place, this energy becomes less and less available for useful purposes, until the system comes to a deadlock, when all progress and activity ceases, and no further work is done by the system. The first law, which tells us that wealth in the form of energy cannot be created or destroyed, so that one molecule cannot grow richer without making another poorer, is much easier of comprehension, and gave Prof. Planck abundant material for discussion.

While the treatment can scarcely be described as exhaustive, this impression may be to a large extent attributed to the changes which have taken place in our knowledge of physical phenomena since the thesis was written. It would have been next to impossible for the author to have brought the book up to date by the inclusion of this later work; and, after all, what has happened in the interval? Have we not, as a general rule, taken the principle of conservation of energy for granted, and merely investigated fresh applications of it? Even in connection with the phenomena of radio-activity, no one has cast any very serious doubts on the validity of the principle. For critical writings on the subject, we must go back to the time of Clausius, Mayer, Joule, and the earlier works of Helmholtz and Lord Kelvin; and these are discussed in the first section. An attempt to draw in recent applications might have confused the issue rather than otherwise.

(2) While many attempts have been made to formulate a physical basis for the phenomena of life—for example, by Loeb in Germany and Dr. F. J. Allen in this country—considerable difficulty is experienced in explaining thought, memory, and the hereditary transmission of characters, none of which concepts appears easily reconcilable with the ordinary properties of matter, at any rate in its inert state. Dr. Gustav Eichhorn would now maintain that electric theories of matter open up new possibilities. For the discovery of electrons, the theory that matter is a complicated aggregate of electrons, and the existence of mutual relations between matter and æther, are fully consistent with the view that the phenomena of thought and heredity are caused by particular states of the æther associated with the molecules of the material organism. Part of the book, dealing with hallucinations and "transcendental memories," was written ten years ago. The author does not profess to give an exhaustive or complete study of the problems with which the book deals, and in view of the fact that the electron theory is comparatively recent, his claims to have treated the subject from a new standpoint are not without foundation; but isn't all this the old notion of spiritualism and "animal magnetism" merely served up under a different name? If not, the resemblance is very striking, and the difference not very obvious.

(3) The collection of articles edited by Dr. Thomas under the designation of "Method in the Sciences" owes its publication to the growing importance attached to philosophy of science, and in particular to methodology in French educational curricula following Auguste Comte. It is pointed out that both textbooks and original articles leave a gap in such literature of the subject as is available for students, and this gap it has been the object of the present volume to assist in filling. In reviewing this book, one is tempted to enlarge on the fact that an educational system which tries to mould all teachers or students according to a common pattern can never be efficient. No better preventive against this deadly uniformity can be suggested than the publication of a book representing the combined experience of all sorts and con-

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ditions of men each a specialist in his own particular department of science; and if it is found that doctors disagree on points of detail, it is claimed that an examination of their views will have the beneficial effect of making the student think for himself instead of merely taking what is written for granted. The mere learning machine, who is frequently devoid of powers of clear exposition, probably exists in every country, but he is not the kind of man to be encouraged. This volume consists of articles on science, by Émile Picard; pure mathematics, by Jules Tannéry; mechanics, by P. Painlevé; general physics, by H. Bouasse; chemistry, by A. Job; morphology, by A. Giard; physiology, by F. Le Dantec; medical sciences, by Pierre Delbet; psychology, by Th. Ribot; sociology and social science, by E. Durkheim; morale, by L. Lévy Bruhl; and history, by G. Monod, all under the editorship of Dr. P. F. Thomas.

(4) Prof. Volkmann's pamphlet is an address delivered at the graduation ceremony of the Albertus University on January 18. It deals with the materialistic philosophy of the nineteenth century, with phenomenology and monism, and with the idealism of Kant, whose connection with the university in question is too well known to require mention.

(5) Dr. Naber deals in a pleasant and chatty way with many points in the history of Greek and Egyptian geometry. The discussion is in no way confined to the proposition now more generally known as "One Forty-Seven," which forms the title of the book, but we have sections dealing with "Pi" and its supposed value $\sqrt{10}$, with spirals and limaçons and their applications to angle-trisection and cube-duplication, with the history of the "Golden" or median section, and finally with the "pentalpha," or pentagonal star, and the dodecahedron. "Spirals in nature and in art" receive considerable attention, and are illustrated by numerous figures. It would be impossible to dwell at length on the historic side of the book. If it has one fault, that fault is a certain diffuseness and lack of definiteness. By this we mean that in some places it is not very certain what conclusions the author is seeking to prove. But possibly that is because the author is endeavouring to give a general idea of what mathematical thought was like in the Pythagorean times, and to do this he reasons largely from conjecture where historic evidence is wanting. He cannot certainly be accused of being long-winded, his sections being very short and concise, and his language terse.

(6) "To save appearances" (σωζειν τα φαινομενα or to account for observed facts was the object of Greek philosophy, which forms the motto of Prof. Duhem's book. Not less is it the object of the modern physicist. In tracing the development of physics from the time of Plato to that of Galileo a good many points may be observed which have left their traces on modern physical theory. We notice, in Prof. Duhem's words, that where we now speak of physics, the Greek and Mussulman philosophers and the men of science of the Middle Age spoke of astronomy; that the laws of motion of celestial bodies were studied ages before anyone thought of applying similar methods to terrestrial (or "sublunary") bodies; that the first discussions of the phenomena of the material world were metaphysical, and that optics and statics were the earliest subjects to form the basis of mathematical theories. We observe with interest the division of physics into two branches, one dealing with celestial and the other with sublunary bodies, of which the first was regarded as infinitely more perfect than the second, and was for this reason wrongly supposed to be only accessible to divine intelligence, while the latter or terrestrial physics was supposed to be summed up in the work of Aristotle. And we reflect that even nowadays the once supposed easier task of "saving the phenomena" of sublunary matter is the one which physicists as a rule shirk. It is true that electricity and not astronomy is the subject now usually under investigation, but in either case the philosopher turns his thoughts to the ether as the seat of the phenomena under investigation, and finds that the hypotheses necessary to "save" these phenomena are greatly simplified owing to the omission of irreversible effects. It is not claimed by Prof. Duhem that his is the first attempt at a history of physics as distinct from mathematics, but as a general account of the subject in a moderate compass it would be difficult to write a better book.

(7) Prof. Gino Loria's book needs little comment. Its merits can be summed up in a few words. It is a book with which no geometer can afford to dispense. It is a bibliography of geometry classified under such headings as "Geometry up to 1850," "Algebraic Curves," "Differential Geometry," "Non-Euclidian Geometry," "Geometry of Multi-dimensional Space." Every page is filled with references, and the number of papers and memoirs which have been consulted in the preparation of the book must be counted by thousands; indeed, if we mistake not, the mere names of authors contained in the index number well into the four figures. The second edition appeared in 1896, and in this third edition the author has added an appendix of about 120 pages dealing with the progress of geometry during the last ten years. In the epilogue, the author compares geometry to a fertile region the vegetation of which still offers numerous prizes in the form of flowers and fruits to the explorer and cultivator. If this analogy be pursued a little further, the need had arisen for a flora of the new territory, and no better botanist could be found for the purpose than Prof. Gino Loria.

THE FLUIDS OF THE BODY IN HEALTH AND DISEASE.

(1) *The Mercers' Company Lectures on the Fluids of the Body.* By Prof. Ernest H. Starling, F.R.S. Pp. viii+186. (London: Archibald Constable and Co., Ltd., 1909.) Price 6*s.* net.

(2) *Studies on Immunisation and their Application to the Diagnosis and Treatment of Bacterial Infections.* By Sir A. E. Wright, F.R.S. Pp. xv+490. (London: Archibald Constable and Co., Ltd., 1909.) Price 16*s.* net.

ALL important as the cells and cellular tissues of the body are, the fluids of the body may claim an equal importance, both in physiological or normal

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